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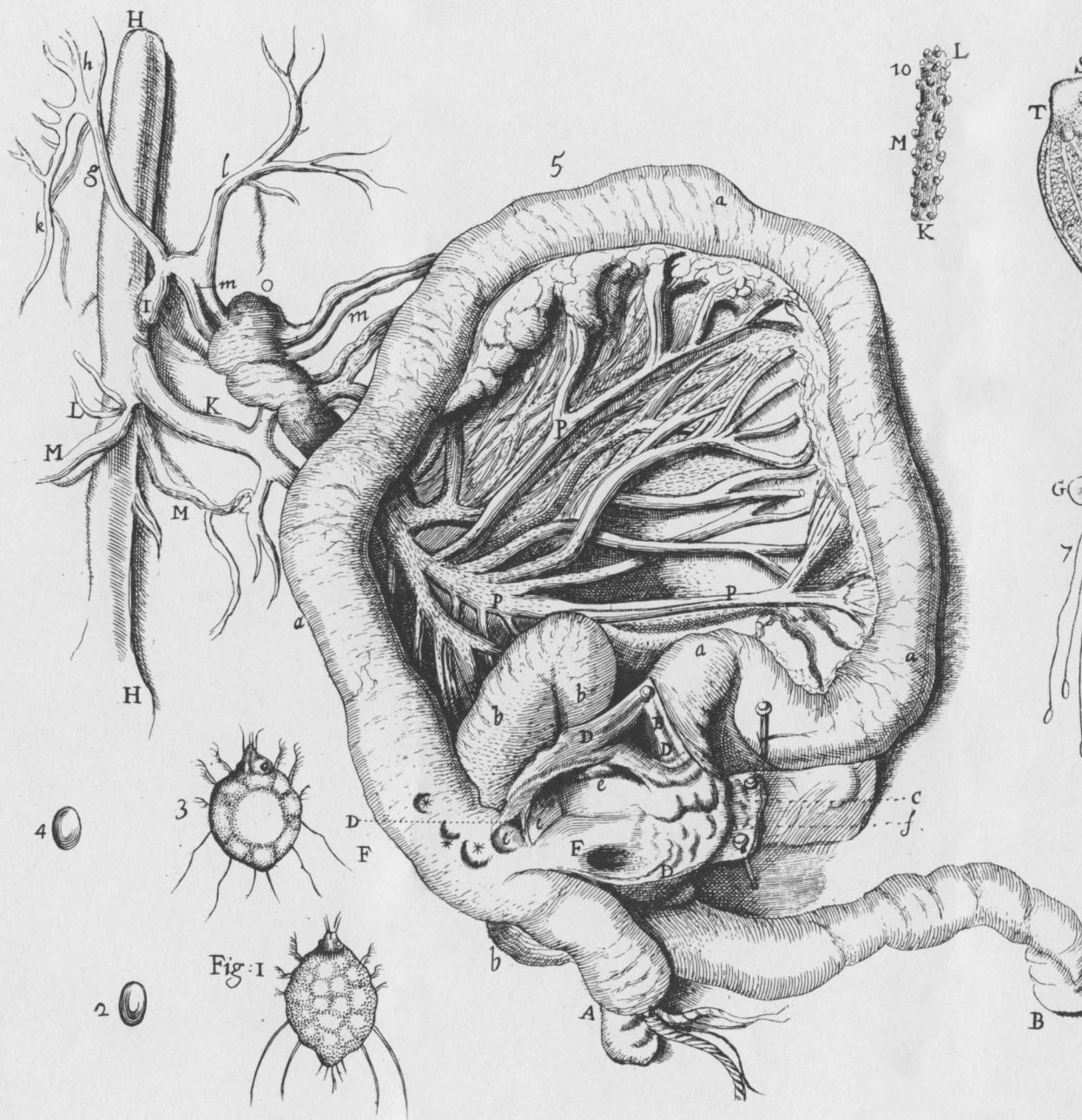
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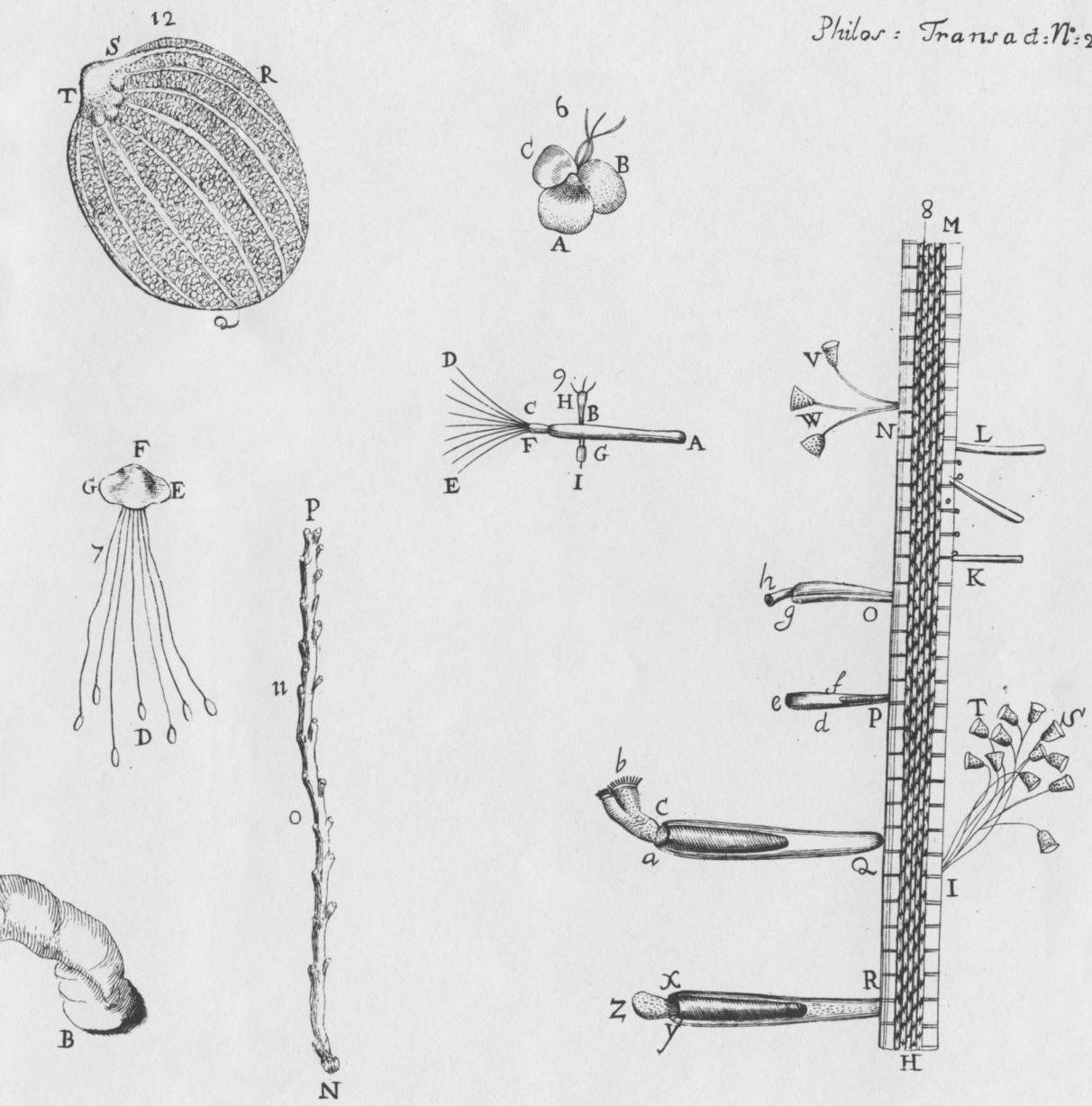
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IV. *Part of a Letter from Mr Antony van Leeuwenhoek, F. R. S. concerning green Weeds growing in Water, and some Animalcula found about them.*

Delft in Holland, 25 Decemb. 1702.

I Have often heard the Common People say, that that Green Stuff or Weeds which are observed to drive upon the Water spring out of the Ground from under the Water.

I could by no means admit of this Assertion, for as often as I have observed the said Green Weeds, I have always found that they are produced from the Seeds of the same kind, as all other Trees and Plants.

I have always observed too, that this Green matter does not grow in Deep Waters, tho they are small and still ; and that wide and shallow Waters abound therewith, and especially Motes and Ditches ; and that the Wind does it no harm.

I have likewise found that the green Weeds in those Ditches which have but little Water in them, are very small in comparison of those in larger Waters, and near the sides of the Banks where they are shallow, and very little motion in them.

Delfs-haven belongs to our Town and lies about 2 hours distance from it ; from that Town, by means of a Sluce, the Water of the River *Maes* with the flood in Summer time, is brought into our Town ; and it is as clear as if the River it self run through the Town.

With this Water comes in also a little of this Green Stuff, but so little that we were half an hour a fishing up 30 of those Weeds and putting them into an Earthen Pot, together with a large quantity of their own Water, for we took

took them up as deep as we could that we might not hurt their Roots.

I took out several of these Weeds from the Pot one by one with a Needle very nicely, and put them into a Glass Tube of a fingers breadth filled with Water, and also in a lesser Tube, and caused the Roots of the Weeds to subside leisurely, and looking upon the same with my Microscope, I was surpriz'd with the sight of a great many and different kinds of *Animalcula*, of which two sorts had long Tayls, whereby they seem'd fast linkt to the Roots of those Green Weeds. These *Animalcula* were in shape like a Bell, and they so stirr'd the round Cavity of their Bodies, that they put the small parts of the Water into such a motion, that I could not see those Instruments they used to produce the said motion.

And, tho I saw 20 of these *Animalcula* together, gently moving their long Tayls and out-stretcht Bodies, they contracted their Bodies and Tayls in an instant, and then softly extended them again; and this kind of motion they continued a great while, so that it was very diverting to observe them. I caused one of these *Animalcula* to be drawn, just as it appear'd fasten'd to the Roots of the aforesaid Green Stuff.

Fig. 6. a, b, c, represents one of these Green Weeds of a common size, as it lay upon the Water, and appeared to the naked Eye of the Limner.

Fig. 7. d, e, f, g, shows you the very same Weed as it appear'd in the Glass Tube filled with Water, with the Roots thereof extended.

Fig. 8. h, i, k, l, m, n, o, p, q, r, represents a small part of the said Root, as it appear'd to the Painter in the Microscope, in which Roots were to be seen the Vessels with their divisions, thro the length of the whole Root; and these Roots, I imagin, were of no longer use, and in a manner wither'd; they were also overgrown with a great many particular long

Particles, and mostly with little Figures like Flowers, as they are here represented in the 8th Fig. between k and l.

The *Animalcula* which I mentioned above, and liken'd to little Belis, are to be seen in the same Figure in i, s, t, and n, v, w; and I saw above a hundred of these *Animalcula* with their Tayls fastn'd to the Root, and living between h, i, k, l, m, but other Roots had none of these.

In several of these Roots I observed one, and sometimes, but seldom two sheaths or cases fastned in them of several sizes, the biggest is represented by r, x, y, Out of the same sheath appear'd a little Creature, the fore-part of whose Body was roundish, as in x, z, y, and presently from the same Rotundity proceeded 2 little Wheels that had a swift Gyration, as in Fig. 8. a, b, c. The Limner observing the Rotation of the Wheels, which always ran one and the same way, could not be satisfied with the sight, adding, O, that he could always see such a wonderful kind of a motion. These small Wheels were as thick beset with Teeth, like the Wheel of a Watch; and when these *Animalcula* had for some time exerted their circular motion they drew their Wheels into their Body, and their Body wholly into their Sheaths, and then soon after thrust them out again with the aforesaid motion; another while they remain'd as it were shut up in their Shells, and tho I observed the same Wheels in other *Animalcula* also, yet their Bodies differed from each other, and the sheaths were of a darkish colour, so that I could not easily perceive the *Animalcula*; and moreover, they seem'd to be composed of Globules.

I also observed other Sheaths that were several degrees smaller then those before mentioned, and they were as transparent as Glass, so that one might plainly see the *Animalcula* lying within them.

Fig. 8. p. d, e, f, represents the Sheath with the little Worm, p, d, f, in it. The same Figure o, g, h, shows you a Sheath with half the Body of the same *Animalcula* g, h, pro-truded

truded out of it, and in which, by reason of its exceeding smallness, one could see the Wheels but now and then, and that only when the said Body was extended, which would soon be comprest or shrunk up.

Moreover, I observed one of these *Animalcula*, whose Body was sometimes long, and sometimes contracted; and about the middle of its Body, which I conceiv'd to be the lower part of its Belly, there was another of the same kind, but smaller, the Tayl of which seem'd to be fastned to the other. I caused one of these *Animalcula* (for the sake of its wonderful Figure and Generation) to be drawn by my Limner, about twice as big as it appeared to the naked Eye, whilst it was in the Water, and fast linkt to the Root of the aforesaid Green Weeds.

Fig. 9. a, b, c, d, e, f, g, show you the *Animalculum* of which a is the Tail wherewith it fastens itself; c, d, e, represents 8 Horns, whereas others that were smaller had but 6; 'tis drawn as stretcht out in its whole length, whereas when it contracted itself, it was not the 4th part so long. The Horns appeared of so wonderful a make to our Eyes, that it almost puzzled the Limner to draw them; however, he drew a small part of one Horn, as in fig. 10. k, l, m.

In Fig. 9 you may see an *Animalculum* b, h, coming out of the Body of the bigger, which *Phenomenon* when I first perceived, I thought it might be a *young Animalculum* fastned by chance to an old one; but observing it more narrowly, I saw it was a *Partus*, for I could now see, that whereas this *Animalculum* (when I first discovered it to be) had but 4 very small Horns, after the space of 16 hours was grown much bigger both in Horns and Body, and 4 hours after that it forsook its Mothers Belly.

In the discovery of the said young *Animalculum*, I had observed on the other side of the Body of the biggest *Animalculum*, a round little knob of Seed that from time to time, and in a few hours grew still bigger, as in Fig. 9. between g and i, and at last grew to be pointed, and in 13

or 14 hours was grown so large, that you might see 2 Horns upon it.

In the space of 24 hours, the last mentioned *Animalculum* had acquired 4 Horns, one of which was small, the second bigger, and the 2 others very large, and these 2 last were more strongly protruded and contracted than the others. Three hours after the little *Animalculum* was got clear of his Mother.

I endeavour'd to pursue my discovery of the Generation of these Creatures, and in order thereto wiped off the Green Weeds from the Body, that I might make my observations the better, but the *Animalculum* was not only dead, but his Horns and part of the Body was quite wasted.

Another *Animalculum* that had brought forth two young ones, had her Body laden with another sort of little Creatures, whose shape was flat beneath and round above, and which I have observed in most Waters ; and this last sort were above a thousand times less than the others whom they crawl'd upon, and hinder'd to go ; but a much bigger *Animalculum*, whose body was almost round, tormented one of the aforesaid Creatures, not only by running upon its Body, but by clinging so fast to one of its Horns, that whatever effort t'other made to be rid of it, she could not shake it off her Body, and at last I found she had lost one of her Horns in the scuffle.

That which seem'd very remarkable, and even wonderful to me, was that the said *Animalcula* would sometimes extend their Horns to so great a length, that looking on them thro the Microscope, you would think they were several fathoms long. I caus'd the Limner to view the manner of the extension and contraction of the Horns, who was amaz'd as well as I to see the same.

I made him also design a small part of the Horn so extended as well as he was able, as you may see in Fig. 11. n, o, p, wherein also are to be observed the knotty Protuberances, as in Fig. 10. k, l, m. These Protuberances seem to be composed

posed of 7 round Globules placed together, *viz.* one in the middle, which was more prominent than the rest, and the others like a Rose round about it.

Now what a number of Vessels and Instruments are to be found in such a small part of a Horn, as is represented in Fig. 11. and fill'd with Bows and Knots like a Rope that is twisted; and perhaps every single knotty Particle is provided with as many Instruments, wherewith to put it into motion.

This *Phænomenon* put me in mind of the knotted Threads, which has employed our Ladies so many years, and I said with myself, if they were to see so perfect and wonderful a work of Nature, how would they bewail their loss of time.

I observed in this Water, or rather in the Green Weeds, abundance of strange *Animalcula*, some of which feed upon the same Green Stuff, and to others it serves instead of skulking holes to hide themselves from the Fish, which would otherwise devour them.

To return to the Generation of the above-mentioned Green Weeds; I have several times observed, that most of the Roots are thickest at the end, and provided with a great many parts that look like Flowers to the Eye, with long Pipes in them, which I take to be a gummy excrementitious matter, which by overspreading the whole Root, causes it to dye or wither. Now whether this is occasioned by want of nourishment (the Weed being quite spent) or whether the same is brought by the Wind or Stream in deep Waters, remains to be consider'd, as also how shallow those Waters must be where this Green Weed can best grow.

I have often dissected some of these small Weeds, which had never yet produced any others, and have taken young Weeds out of them, which were so very small that they escaped my naked Eye.

Let us suppose that fig. 6. a, b, c, which we call a Green Weed, is compos'd of three entire Weeds, of which that part

part markt A, we'll call the Mother Plant, from whence proceed several Roots; first the Plant B is immediately produced by the said Mother-Plant, and joyn'd to it by a string that as it grows conveys its nourishment to it, till it be provided with Roots of its own; before the Weed B is arrived to its full growth, A has brought forth another markt C, and that has no Root; now if we should distract one of those Weeds, even tho they were never so small, we shall find young unborn Weeds within them.

I open'd one of these immature Weeds in the presence of my Limner, and took out such an Embryo as is before describ'd, and placing it before my Microscope I made him draw it immediately, before that the Moisture of it should exhale, for if that should happen, the Vessels through which it receives its Increase in Nourishment could not easily be described.

Fig. 12. represents a Weed which I had taken out of another of the bigness of c, in Fig. 6. this Weed received its nourishment by that part markt S, T. Between s, t, inwards you may observe five small Particles, which I imagine to be also young Weeds; and that part too that lies between s, t, outward, is a young Weed as well as the rest, tho one would hardly think so, as it is here represented, but that change of its figure happen'd by the exhalation of the Moisture, for when I put it into the Limners hands it had as round and as entire a shape as this same Fig. 12. Q, R, S, T.

This being so, those who assert that these Green Weeds spring from under the Earth, ought to be sham'd of their prejudices, seeing they do proceed from a Seminal Matter as well as other Plants.

That I might yet more fully satisfy my self, I caus'd some of these Weeds to be taken out of a Ditch belonging to a Linnen Bleecher that was in disuse, because no fresh Water could be brought into it. The Ditch was full of these Weeds, but the biggest of them were much smaller than the before-mention'd, but their Leaves much thicker.

Having examin'd these Weeds, I found, that altho' they were arrived to their full growth, they had but two Roots which were longer than the Roots of the first Weed, and when I viewed the smaller Weeds, I could perceive they had a great many, but very short Roots.

Whilst I was observing the last Weed, I saw with wonder a great number of Animalcula swimming in Circles thro' the Water, and so thick together, that even to the naked Eye they seem'd like a Cloud; I never saw any of these little Creatures in other Waters, and the next day they were all gone.

There was a great many sorts of these Animalcula, and each had their different Motion, and all so small as to escape our naked Eyes.

Among these, I observed some which were much bigger than the rest, and were coupled together, in which action they lay very still on the sides of the Glass, but a bigger sort interrupted them; whilst they were quiet, I could easily see those parts which they use in motion, and also the motion of several parts of their Body, which some would take for the Circulation of the Blood; but I rather esteem it the Chile in the Guts. These Animalcula were so big, that one might see them in clear Water and in a Glass Tube, amongst several of these sorts I could perceive some as big as little Sands, and as compleatly formed as our Garden Spiders.

R r r r r r r

V. Afro-